PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
800304WO		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/FI2004/000516	03-09-2004	30-09-2003
International Patent Classification (IPC) or national classification and IPC		
See Supplemental Box		
Applicant		
Nokia Corporation et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 6 sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25-07-2005	16-01-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Peter Hedman/MN Telephone No. +46 8 782 25 00

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

INTERNATIONAL PATENT CLASSIFICATION (IPC):

G01S 1/00 (2006.01)
G01S 5/14 (2006.01)
H04Q 7/38 (2006.01)
G01S 5/00 (2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/FI2004/000516

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-3,6-20 as originally filed/furnished
pages* 4,5 received by this Authority on 09-01-2006
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 21-24 received by this Authority on 09-01-2006
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1-4 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/FI2004/000516

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-27	YES
	Claims		NO
Inventive step (IS)	Claims		YES
	Claims	1-27	NO
Industrial applicability (IA)	Claims	1-27	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The invention concerns a method for providing location assistance information to a mobile station in a communications network and solves the problem of providing data suitable for positioning a mobile station in a fast and accurate way. The aim of the invention is to provide location assistance information of the best suited satellites to the mobile station.

Reference is made to the following documents:

D1: US 6 392 593 B1
D2: US 6 204 808 B1
D3: US 6 215 441 B1 (cited in the application)

The cited documents represent the general state of the art.

The invention defined in the amended claims 1-27 is not disclosed by any of these documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed method for providing location assistance information which is sent in an order dependent on the estimated visibilities with respect to the mobile station. Therefore, the claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1-27 is novel and is considered to involve an inventive step. The invention is industrially applicable.

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of GPS reference receivers forming a GPS reference network. Location assistance information is sent to a mobile station about appropriate satellites. The appropriate GPS satellites are determined based on the approximate location of the mobile GSP receiver. The approximate location of the mobile GPS receiver may be determined from the cell identifier of the land based telephone system cell communicating with the mobile GPS receiver.

An object of the embodiments of the present invention is to overcome problems relating to providing location assistance information.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the invention, there is provided a method for providing location assistance information to a mobile station of a communications network, the method comprising the steps of:

- estimating visibilities of a plurality of satellites with respect to the mobile station, said plurality of satellites being satellites of a satellite positioning system,
- selecting a group of said plurality of satellites with the best estimated visibilities with respect to the mobile station, and
- sending to the mobile station location assistance information relating to at least said group of satellites, wherein location information relating to said group of satellites is sent in an order dependent on the estimated visibilities with respect to the mobile station.

In accordance with a second aspect of the present invention, there is provided a network element for providing location assistance information to a mobile station of a telecommunications network, the network element being configured to

estimate visibilities of a plurality satellites with respect to a mobile station, said satellites being satellites of a satellite positioning system,

select a group of said plurality of satellites with the best estimated visibilities with respect to the mobile station, and

send to a mobile station location assistance information relating to at least said group of satellites, wherein location information relating to said group of satellites is sent in an order dependent on the estimated visibilities with respect to the mobile station.

In accordance with a third aspect of the present invention, there is provided a communications system for providing location assistance information, said communications system comprising

- at least one reference receiver of a satellite positioning system for obtaining location assistance information relating to satellites of the satellite positioning system,
- means for estimating visibilities of a plurality of satellites of the satellite positioning system with respect to a mobile station,
- means for selecting a group of said plurality of satellites with the best estimated visibilities with respect to the mobile station, and
- means for sending to the mobile station location assistance information relating to said group of satellites, wherein location information relating to said group of satellites is sent in an order dependent on the estimated visibilities with respect to the mobile station.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows as an example a cellular telecommunications system, where embodiments of the invention are applicable;

Figure 2 shows, as examples, two serving areas relating to two reference satellite positioning system receivers;

Figure 3 shows a flowchart of a method in accordance with an embodiment of the invention; and

Figure 4 shows a block chart of a network element in accordance with the embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Figure 1 illustrates, as an example, a schematic view of a cellular telecommunications network 10 supporting positioning services. The cellular telecommunications network 10 contains a radio access network 12 and a core network 20. The radio access network 12 has a plurality of base station controllers (BSC) 14 responsible for controlling the radio resources. A base station controller 14 may control a plurality of base stations (BS) 16, which are typically connected to a base station controller with a fixed line connection or, for example, with a point-to-point radio or microwave link. A base station controller 14 is responsible for controlling and managing the radio resources in a base station 16. The core network 20 contains Mobile Switching Centers (MSC) 22, a Home Location Register (HLR) 24 and Visitor Location Registers (VLR) 26. Figure 1 illustrates, as an example, only one BSC, MSC and VLR.

Claims

1. Method for providing location assistance information to a mobile station of a communications network, the method comprising the steps of:

- estimating visibilities of a plurality of satellites with respect to the mobile station, said plurality of satellites being satellites of a satellite positioning system,
- selecting a group of said plurality of satellites with the best estimated visibilities with respect to the mobile station, and
- sending to the mobile station location assistance information relating to at least said group of satellites, wherein location information relating to said group of satellites is sent in an order dependent on the estimated visibilities with respect to the mobile station.

2. A method as defined in claim 1, wherein said group of satellites contains a predetermined number of satellites.

3. A method as defined in claim 1 or 2, wherein location assistance information relating to said group of satellites is sent in one location assistance message.

4. A method as defined in claim 1 or 2, wherein location assistance information relating to said group of satellites is sent using a plurality of location assistance messages, each location assistance message of said plurality of location assistance messages containing information about one satellite of said satellite positioning system.

5. A method as defined in any preceding claim, wherein location assistance information relating to said group of satellites is sent in response to receipt of a location assistance information request from the mobile station.

6. A method as defined in any one of claims 1 to 4, wherein location assistance information relating to said group of satellites is sent periodically.

7. A method as defined in claim 1, further comprising the steps of selecting a further group of satellites with the next best estimated visibilities with respect to the mobile station.

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8. A method as defined in claim 7, wherein location assistance information relating to said group of satellites is sent to the mobile station before location assistance information relating to said further group of satellites.

9. A method as defined in claim 7 or 8, wherein location assistance information relating to said group of satellites is sent in a first location assistance message and location assistance information relating to said further group of satellites is sent in a second location assistance message.

10. A method as defined in claim 7 or 8, wherein location assistance information is sent using a plurality of location assistance messages, each location assistance message of said plurality of location assistance messages containing information about one satellite of said satellite positioning system.

11. A method as defined in any one of claims 7 to 10, wherein location assistance information relating to said group of satellites is sent in response to receipt of a location assistance information request from the mobile station.

12. A method as defined in claim 11, wherein location assistance information relating to said further group of satellites is sent to the mobile station upon a request for location assistance information relating to said further group.

13. A method as defined in any one of claims 7 to 10, wherein location assistance information relating to said group of satellites is sent periodically.

14. A method as defined in claim 13, wherein location assistance information relating to said further group of satellites is sent as often as location assistance information relating to said group of satellites.

15. A method as defined in claim 13, wherein location assistance information relating to said further group of satellites is sent less often than location assistance information relating to said group of satellites.

16. A method as defined in any one of claims 7 to 15, wherein location information relating to said group of satellites and to said further group of satellites

is sent in an order dependent on the estimated visibilities with respect to the mobile station.

17. A method as defined in any preceding claim, wherein said group of satellites contains three or four satellites of the satellite positioning system.

18. A method as defined in any preceding claim, further comprising the step of estimating visibilities of the satellites based on elevation angles of the satellites with respect to an estimated location of the mobile station.

19. A method as defined in claim 18, wherein obstructions in the vicinity of the estimated location of the mobile station are taken into account in estimating visibilities of the satellites with respect to the mobile station.

20. A method as defined in any preceding claim, wherein said location assistance information is for a mobile-assisted location method.

21. A method as defined in any one of claims 1 to 19, wherein said location assistance information is for a mobile-based location method.

22. A network element for providing location assistance information to a mobile station of a communications network, the network element being configured to

estimate visibilities of a plurality satellites with respect to a mobile station, said satellites being satellites of a satellite positioning system,

select a group of said plurality of satellites with the best estimated visibilities with respect to the mobile station, and

send to a mobile station location assistance information relating to at least said group of satellites, wherein location information relating to said group of satellites is sent in an order dependent on the estimated visibilities with respect to the mobile station.

23. A network element as defined in claim 22, further configured to receive location assistance information relating to satellites of said satellite positioning system.

24. A network element as defined in claim 22 or 23, wherein the network element is a location server.

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25. A communications system for providing location assistance information, comprising

- at least one reference receiver of a satellite positioning system for obtaining location assistance information relating to satellites of the satellite positioning system,
- means for estimating visibilities of a plurality of satellites of the satellite positioning system with respect to a mobile station,
- means for selecting a group of said plurality of satellites with the best estimated visibilities with respect to the mobile station, and
- means for sending to the mobile station location assistance information relating to said group of satellites, wherein location information relating to said group of satellites is sent in an order dependent on the estimated visibilities with respect to the mobile station.

26. A communications system as defined in claim 25, wherein said means for estimating visibilities of satellites with respect to the mobile station are provided in a location server.

27. A communications system as defined in claim 25, wherein said means for estimating visibilities of satellites with respect to the mobile station are provided in a number of network elements.